

Editorial

Toward Sustainable and Low Carbon Road Transportation: Policies, Tools, and Planning Methods

Andres Monzon *  and Yang Wang 

Transport Research Centre (TRANSyT), Technical University of Madrid, 28040 Madrid, Spain;
yang.wang@upm.es

* Correspondence: andres.monzon@upm.es

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1. Introduction

The road sector is the dominant transport mode in terms of demand for both passengers and goods. But at the same time, it is responsible for almost 72% of total greenhouse gas emissions from transport (including international aviation and international shipping) [1]. The Special Issue on *Sustainable Road Transportation Planning* was inspired to investigate how to face the challenges on emissions reduction and to look ahead for advanced solutions from the planning and operational side.

During the last decade, road transportation has faced overwhelming changes: New travel modes have emerged, advanced information and communication technologies (ICT) have aided mobility service provision, and new regulations and economic standards appeared. No matter whether transportation services are new or traditional, road planning should consider sustainability targets to improve social, environmental, and economic requirements, meaning low carbon and more efficient transport networks.

Under this consideration, **14 papers** by authors coming from **11 countries** contributed to construct a picture of recent findings and techniques on the road transportation sector toward sustainable planning.

2. Contents and Contributions of Collections

The current Special Issue involves planning methodologies, actions, and techniques toward sustainable road transportation planning. It addresses a range of topics such as decarbonization, environmental quality, ICT and changing behavior, optimal traffic assignment, and prioritization of sustainable modes. It consists of one review paper and thirteen specific research papers that can be categorized in the following four topics.

2.1. Transport Planning for Reducing Emissions

The first three papers (contribution 1–3) address issues about general transport planning methods both for public and private modes. More specifically, Zeng et al., (contribution 1) proposed an equilibrium bus-boarding model to obtain optimal pricing and service, with the aim of eliminating the congestion and improve bus-boarding efficiency during peak periods. Through their findings, they recommend that transit authorities should reduce to a minimum the deadweight loss on the boarding queuing congestion during the peak period using optimal pricing and service and adopting the optimal bus headway for improving service performance.

The work of Osorio-Tejada et al., (contribution 2) proposed a method for estimating energy consumption and emissions based on vehicle operating conditions in regions with different topology, such as Colombia, Malaysia, and Spain. It considered the load factor, gradients, and speed for the different slopes to estimate energy consumption and emissions, unlike the previous similar studies. The results show the heterogeneity of energy consumption by driving conditions, which helps to facilitate and to reduce uncertainty in the environmental accounting of freight companies in different geographies.

Sobrino and Monzon (contribution 3) describe a comprehensive methodological tool (called HERA: Highway EnerRgy Assessment) for identifying hot-spots in road segments and corridors in terms of GHG (GreenHouse Gas) emissions. It was applied to the Spanish highway network to identify priority low-carbon actions. The results coincide with (contribution 2), which states that high rates of heavy vehicles, high speeds, and steep gradients increase fuel consumption and emission rate. Speed control appears as the most effective strategy, producing 3.5% emissions reduction by reducing speed by 10 km/h.

2.2. *Changing Travel Behavior toward Sustainable Road Modes*

As many new mobility modes have emerged over the last decade, it has contributed to the reduction of private vehicle trips and emissions in cities. Based on the findings of previous papers (contribution 4–6), key factors are identified to attract travelers towards innovative new sustainable modes. Three groups of researchers from different countries (China, Germany, and Israel) studied the adoption of new transport solutions (electric vehicle sharing, electric bike sharing, and ridepooling), identifying key factors through distinct survey methods.

Zhang et al., (contribution 4) present a deep understanding of the acceptance of electric vehicle (EV) sharing and the strategy for promoting it in cities. Through a survey on eV users, they showed the factors with positive contributions to EV-sharing acceptance. Policies of more accessible resources, improving social pressure, and strengthening policy support are recommended to promote EV sharing acceptance.

Elias and Gitelman (contribution 5) conducted an opinion survey on young electric bicycle (EB) riders. Its aim was to record and analyze the characteristics and general perception of teen e-B users and to explore their behaviors. The results show that EBs would increase the frequency and the distance of daily teens' commuter trips. But, at the same time, it improves mobility independence, allowing less reliance on parents and an increase of potential destinations. It also suggests that a combination of road safety education and training with an improvement of existing infrastructure are the best way to tackle this new and widespread phenomenon.

The aim of the work of König et al., (contribution 6) is similar to contribution 4, aiming at identifying the characteristics of ride-poolers and their preferences, but these authors (contribution 6) used choice-based Conjoint Analysis based on a literature review and a focus group. The findings show the high relevance of fare and walking distance to the pick-up point also plays a key role for elders.

2.3. *Advanced Methods for Sustainable Transport Planning*

Four papers (contribution 7–10) present diverse methods for improving traditional transport planning models by considering environmental factors. First, contribution 7 presents the method to obtain an origin–destination matrix by smart card data for a large area. Contribution 8 and contribution 9 consider extra factors, either with less emission or less road maintenance fees, to assign traffic in optimized way. The last work of this group presents a new concept of resource science to identify inefficient transport in urban areas.

Pronello et al., (contribution 7) defined an algorithm capable of building the origin–destination matrix from smart card data collected in Torino, Italy. The work has findings on AFC (automated fare collection systems) systems and origin–destination estimation in large areas to assist public transport operators and local authorities on the design, the supply, and the characteristics of mobility services.

Tu et al., (contribution 8) considered environmental costs into the advanced traveler information system (ATIS) to obtain “eco-routing” for two classes of travelers who were assigned based on stochastic network user equilibrium (SUE) model. The corresponding algorithm was also proposed. Both the model and algorithm were tested by numerical examples. The developed algorithm can provide new ideas for traffic planners and managers to reduce environmental costs caused by traffic.

Mao et al., (contribution 9) present a new an optimized traffic assignment model considering not only minimum travel time but also minimum pavement damage by establishing a multi-objective DTA (Dynamic Traffic Assignment) model. The teaching–learning-based optimization (TLBO) algorithm was utilized to solve the proposed model. A case study was used to confirm its effectiveness. The findings include identifying vehicle types that have higher pavement damage and validating the new model to save the total maintenance expenditures and extend pavement service life-span, even though a little increase in travel time is expected.

The work of Cao et al., (contribution 10) is the fourth paper that innovatively adopted the concept of “wasteful transport” from the perspective of resource science to identify the boundary between normal and inefficient transport in urban traffic flow. It constructed the flow–density relationship model of road traffic and validates the model via an empirical study on the traffic conditions in Shanghai.

2.4. Assessment of Sustainable Road Transport Policies and Technologies

The last group of papers (contribution 11–14) focus on analyzing potential benefits or limitations of technological progresses, travel behavior changes, and transport investment. They attempt to draw the relationship of policies/technologies application and its impacts towards sustainability.

Martínez-Díaz et al., (contribution 11) present the only review paper in the Special Issue. It demonstrates that the random introduction of technology does not imply benefits to society through literature review. The authors performed a comprehensive multi-criteria analysis based on Analytic Hierarchy Process (AHP) and evidential reasoning to appraise seven emerging technologies in road traffic. Their findings evidence that the potential improvement in personal mobility will not become a reality if it exclusively relies on the latest technological devices, in line with consumers’ fantasies or economic interests.

Li et al., (contribution 12) investigated the factors that link driving with vehicle fuel consumption efficiency based on the long-term Controller Area Network (CAN) data collected in Toyota City, Japan. They explored the relationships between drivers’ fuel consumption efficiencies and factors including drivers’ characteristics, car attributes, date-specific environmental attributes, and travel behavior. Furthermore, a multi-level model was applied to explicitly incorporate the effects of individual-specific, date-specific, and observation-specific unobserved factors. The results are that, on working days, model fit was significantly enhanced by incorporating all three error terms. Several findings regarding the relationships between observed factors and drivers’ fuel consumption efficiencies were also obtained.

Wang and Boggio Marzet (contribution 13) assessed the impact of an eco-driving training program on fuel savings and reduction of CO₂ emissions in a well-designed field trial in Madrid, Spain, focusing on the specific impacts according to road type. The final results show a general fuel saving after eco-driving training of up to an average of 6.3%, regardless of fuel and road type. The highest fuel savings were achieved on major arterial road sections with a certain number of roundabouts and pedestrian crossings.

The research of Guzman et al., (contribution 14) used a cross-sectional analysis of accessibility changes between 2011 and 2015 after 74% of the new bus routes were implemented in Bogotá. Results show that the location of low-income settlements implies a disadvantage as a consequence of spatial segregation that increases distances to job opportunities. By comparing the changes, it finds public transport in Bogotá still fails to improve accessibility, reinforcing gaps between rich and poor groups instead of closing them. Solving these accessibility differences are key for increasing public transport patronage to assure more sustainable urban mobility.

3. Conclusions

Road transportation is vital for the economy and society because it carries the vast majority of both passengers and goods, but also it is an access mode to other transport modes in multimodal trips. New trends on digitalization, sharing economy, automation, and environmental values open new opportunities to improve transport planning methods and road operation efficiency. This Special Issue presents a broad range of studies on road transportation planning and its applications throughout the world. The collected papers barely represent all advanced processes in the sector, but they open a window to point out new directions to face challenges on energy and climate with new and traditional planning methods. New public policies toward a more sustainable road transportation system will be based on the main outputs of the research works included in this special issue of *Sustainability*.

4. List of Contributions

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3. Sobrino, N., & Monzon, A. (2018). Towards Low-Carbon Interurban Road Strategies: Identifying Hot Spots Road Corridors in Spain. *Sustainability*, 10(11), 3963.
4. Zhang, K., Guo, H., Yao, G., Li, C., Zhang, Y., & Wang, W. (2018). Modeling Acceptance of Electric Vehicle Sharing Based on Theory of Planned Behavior. *Sustainability*, 10(12), 4686.
5. Elias, W., & Gitelman, V. (2018). Youngsters' Opinions and Attitudes toward the Use of Electric Bicycles in Israel. *Sustainability*, 10(12), 4352.
6. König, A., Bonus, T., & Gripenkoven, J. (2018). Analyzing Urban Residents' Appraisal of Ridepooling Service Attributes with Conjoint Analysis. *Sustainability*, 10(10), 3711.
7. Pronello, C., Longhi, D., & Gaborieau, J. B. (2018). Smart Card Data Mining to Analyze Mobility Patterns in Suburban Areas. *Sustainability*, 10(10), 3489.
8. Tu, Q., Cheng, L., Li, D., Ma, J., & Sun, C. (2018). Stochastic Transportation Network Considering ATIS with the Information of Environmental Cost. *Sustainability*, 10(11), 3861.
9. Mao, X., Wang, J., Yuan, C., Yu, W., & Gan, J. (2018). A Dynamic Traffic Assignment Model for the Sustainability of Pavement Performance. *Sustainability*, 11(1), 1-19.
10. Cao, X., Zhou, B., Tang, Q., Li, J., & Shi, D. (2018). Urban Wasteful Transport and Its Estimation Methods. *Sustainability*, 10(12), 4562.
11. Martínez-Díaz, M., Soriguera, F., & Pérez, I. (2018). Technology: a necessary but not sufficient condition for future personal mobility. *Sustainability*, 10(11), 4141.
12. Li, D., Li, C., Miwa, T and Morikawa, T. (2019). An Exploration of Factors Affecting Drivers' Daily Fuel Consumption Efficiencies Considering Multi-Level Random Effects. *Sustainability*, 10(11)
13. Wang, Y., & Boggio-Marzet, A. (2018). Evaluation of Eco-Driving Training for Fuel Efficiency and Emissions Reduction According to Road Type. *Sustainability*, 10(11), 3891.
14. Guzman, L., Oviedo, D., & Cardona, R. (2018). Accessibility Changes: Analysis of the Integrated Public Transport System of Bogotá. *Sustainability*, 10(11), 3958.

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Reference

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